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# Zea diploperennis: A Primitive Relative Offers New Traits to Improve Corn[1]

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Four years ago, a young Mexican botanist made what may someday be recognized as the "botanical find of the century." Rafael Guzmân, a student at the University of Guadalajara, was searching for one of the wild relatives of corn in the mountains of southern Mexico. Guzmân was looking for *Zea perennis*, a perennial "teosinte" thought to be extinct in the wild since the early 1920's. This primitive corn relative was considered more of a botanical curiosity than a boon to mankind. As a tetraploid, perennial teosinte produces sterile offspring when crossed with corn, a diploid species. Guzmân found perennial teosinte growing in a remote mountain site.

At another location, he found what he thought to be another stand of this plant species. However, Professor Hugh H. Iltis and his former student, John F. Doebley, of the University of Wisconsin, determined that Guzmân's second find was a species not previously known to exist. They described and named the new species **Zea diploperennis.** This diploperennial teosinte is a diploid and produces fertile offspring when crossed with corn. The long dreamed of possibility of producing a perennial corn was suggested by Iltis and his colleagues as a potential use for the new teosinte.

The advantages of growing a perennial corn are obvious. Once planted, the crop could be harvested for several years without replanting, offering considerable savings in time and money. There are also potential disadvantages of a perennial corn. A perennial must divide its nutrient resources between the seed and its rhizomes, the overwintering structures. Therefore, a perennial corn plant might not be expected to produce as much grain as an annual. Also it might not be possible to grow a perennial corn plant in the northern corn growing regions of the United States where winters are often severe. Frost occurs in the mountains of southern Jalisco where diploperennial teosinte grows, but the ground does not freeze as it does in the Cornbelt states. In two consecutive years, diploperennial teosinte planted in Ohio has not survived the winter. The rhizomes froze and rotted.

Nevertheless, diploperennial teosinte theoretically could survive the milder winters of the southern United States. In this region, a perennial grain corn or perhaps a vigorous forage corn could be developed. Hybrids between diploperennial teosinte and maize grown in Ohio have produced giants reaching 10-12 feet tall.

Perenniality may not be the most useful trait that diploperennial teosinte can provide for corn. There is potential for improving annual dent corn with useful genes from this wild corn relative.

This possibility is what spurred the interests of members of the maize virus research team at the Ohio Agricultural Research and Development Center. OARDC workers joined Iltis and Guzmân on subsequent expeditions to the mountain sites where diploperennial teosinte had been discovered. They suspected that diploperennial teosinte's long survival in the wild was because of genetic immunity or tolerance to insect pests and diseases. Perennials generally are more resistant to systemic plant diseases than are annuals.

Tests were inititated at the OARDC to measure susceptibility of diploperennial teosinte and other teosinte *(Zea)* species to various systemic maize diseases. A program of crossing and backcrossing the diploperennial teosinte with modern corn was also initiated.

Tests with diploperennial teosinte have confirmed that **it is immune or tolerant to several important viral and mycoplasmal diseases** (Table 1). In many

[1]This information originally appeared in the *Ohio Report on Research and Development in Agriculture, Home Economics, and Natural Resources* 66(6): 90-92. November-December, 1981.

*Roots of the type collection of* **Zea diploperennis,** *showing development of perennial rhizomes. Photo by Hugh H. Iltis.*

**Table 1.** Susceptibility of **Zea diploperennis** to viral and mycoplasmal diseases of corn.[1]

| Disease pathogen | Reaction of Zea diploperennis | Comments |
|---|---|---|
| Maize chlorotic dwarf virus | **Immune** | This is one of the two most serious virus diseases in the United States. **No other source of virus immunity is known.** |
| Maize dwarf mosaic virus, Strain B | Immune or Tolerant | Tolerant but not viral immune corn lines have previously been developed. |
| Maize dwarf mosaic virus, Strain A | Susceptible | Tolerant and viral immune dent corn has previously been developed. |
| Maize chlorotic mottle virus | **Immune** | This virus causes serious disease in Kansas and Nebraska and in South America. **No other immune source is known.** |
| Maize streak virus | **Immune** | The most serious viral disease in Africa. **No other virus immune source is known.** |
| Maize stripe virus | Tolerant | This virus, widely distributed in tropical countries, **has little effect on Zea diploperennis.** |
| Maize rayado fino virus | Tolerant | This virus, found in the American tropics, **has little effect on Zea diploperennis.** |
| Maize bushy stunt mycoplasma | **Immune** | This mycoplasma causes a serious disease in corn at high elevations in the American tropics. |
| Corn stunt spiroplasma | Susceptible | Spiroplasma causes a serious disease in corn at low elevations in the American tropics. |

[1]Summarized from 1) Nault, L.R. 1980. Maize bushy stunt and corn stunt: A comparison of disease symptoms, pathogen host ranges and vectors. **Phytopathology** 70: 659-662; 2) Nault, L.R., R.E. Gingery and D.T. Gordon. 1980. Leafhopper transmission and host range of maize rayado fino virus. **Phytopathology** 70: 709-712; 3) Nault, L.R., D.T. Gordon, V.D. Damsteegt and H.H. Iltis. 1982. Response of annual and perennial teosintes (*Zea*) to six maize viruses. **Plant Disease** 66:61-2.

instances, this represents the only known source of such germ plasm for corn.

The cooperative state-Federal corn breeding program is currently developing dent corn resistant to maize chlorotic dwarf virus (MCD), one of the two most serious viral diseases of corn in the United States. Resistance to MCD does not appear to exist in other corn germplasm. Initially, pollen from diploperennial teosinte was used to pollinate the silks of several corn plants. Only a few seeds were obtained from each cross, perhaps because the smaller pollen grains of diploperennial teosinte lack the vigor to travel the long silk channels of corn to reach the embryo sac. Pollen of first generation hybrid plants from crosses of corn and diploperennial teosinte was used to pollinate other corn plants.

Resulting first generation backcross plants were inoculated with MCD using viruliferous leafhoppers. Immune plants were separated from susceptible ones and were used to produce second generation backcrosses. The second generation backcross plants were tested for MCD resistance and used to pollinate other corn plants. These third generation backcross seeds will be theoretically 93.75% corn and 6.25% diploperennial teosinte.

By continued backcrossing to Cornbelt corn types it is hoped that parent inbred lines resistant to MCD, as well as to strain B of maize dwarf mosaic virus, another important corn virus in the United States, will be developed. It likely will be ten years before corn hybrids resistant to MCD are available for farmer plantings. In addition to transferring virus resistance, it must be fixed in a homozygous condition and the resulting inbred lines tested for performance in hybrid combinations.

Diploperennial teosinte **may help provide resistant germplasm for foliar and root pathogens as well as insect pests such as corn earworms, stalk borers, and rootworms.** Ohio breeding studies also suggest that diploperennial teosinte may provide **genes for greater stalk and root strength, multiple ears per plant, and tolerance to poorly drained soil.** We are just beginning to realize the potential contributions that diploperennial teosinte can offer for the improvement of corn. This potential may validate the claim for hailing Rafael Guzmán's diploperennial teosinte as the "botanical find of the century."